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**United States Patent** [19]

Nishi et al.

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[54] **ILLUMINATION OPTICAL APPARATUS  
USING DIFFERENT NUMBER OF LIGHT  
SOURCES UNDER DIFFERENT EXPOSURE  
MODES, METHOD OF OPERATING AND  
METHOD OF MANUFACTURING THEREOF**

[75] Inventors: **Kenji Nishi, Yokohama; Naomasa  
Shiraishi, Kawasaki, both of Japan**

[73] Assignee: **Nikon Corporation, Tokyo, Japan**

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**Related U.S. Application Data**

[62] Division of application No. 08/921,311, Aug. 29, 1997, Pat. No. 5,815,248, which is a continuation of application No. 08/636,272, Apr. 29, 1996, abandoned, which is a continuation of application No. 08/231,159, Apr. 22, 1994, abandoned.

**[30] Foreign Application Priority Data**

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[51] **Int. Cl.<sup>6</sup>** ..... **G03B 27/54**

[52] **U.S. Cl.** ..... **355/70; 355/67; 355/69;**  
359/619

[58] **Field of Search** ..... 355/67, 69, 70;  
359/619

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*Primary Examiner*—David Nelms

*Assistant Examiner*—Andrew Q. Tran

*Attorney, Agent, or Firm*—Vorys, Sater, Seymour and Pease LLP

**[57] ABSTRACT**

A diffraction grating is set between a light source and a fly-eye lens composed of a plurality of lens elements rectangular in cross section, and using the zeroth order diffraction beam and  $\pm$ first order diffraction beams emergent from the diffraction grating, a plurality of light source images are formed along the longitudinal direction on the exit plane of each lens element in the fly-eye lens. In a preferred mode the intensity of illumination light on a mask is increased using first and second light sources, and first illumination beam, which is obtained by combining a beam emitted from the first light source and passing through a half prism with a beam emitted from the second light source and reflected by the half prism on a same axis, and a second illumination beam, which is obtained by combining a beam emitted from the first light source and reflected by the half prism with a beam emitted from the second light source and passing through the half prism on a same axis, are made incident into the fly-eye lens as being inclined symmetrically with each other with respect to the optical axis of illumination optical system.

**31 Claims, 12 Drawing Sheets**